ANGLE CLAMP WITH Z-AXIS ATTACHMENT AND QUICK ACTING BUTTONS

Note: This application is based on my provisional patent application filed on July 8, 2002 with application number 60/393,874.

REFERENCE

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improved clamping device which can be used to hold workpieces in a three dimensional 90-degree relationship with the addition of the Z-axis attachment. And the workpieces can easily be removed after work by pressing the quick acting buttons to release the threaded shafts mounted with the clamping heads. The swing away clamping arm of the Z-axis attachment gives even more room for easier removal of the workpieces if necessary.

2. Description of the Related Art

A typical clamp (or vise) generally includes a fixed head (or jaw) and a movable head (or movable jaw) attached to one end of a threaded shaft. Clamping action is achieved by turning the threaded shaft so that the movable head is moved towards the fixed head against the workpiece. By turning the threaded shaft counterclockwise, the movable head is moved away from the fixed head and hence the workpiece is released. With such a device, a workpiece is clamped in one direction, or one dimensional. To clamp workpieces in two or three different directions, two or three such devices have to be used and fixed to a specially constructed fixture which provides the multi-dimensional relationship of the workpieces. However, the setup of this fixture is time-consuming and sometimes inconvenient.

Furthermore, the movable heads have to be moved in or out individually by turning the corresponding threaded shaft clockwise or counterclockwise to adjust for different sizes of workpieces. This is another time-consuming process.

The present invention is intended to simplify the procedures and minimize the time consumed in clamping the workpieces in a three-dimensional mutually perpendicular relationship and in releasing the assembled workpieces after work.

BRIEF SUMMARY OF THE INVENTION

An angle clamp in accordance with the present invention comprises three mutually perpendicular base plates, one square shape bottom-plate and two smaller rectangular side-plates. The bottom-plate includes two slotted holes along two adjacent edges which are not connected to the side-plates, one along each edge, so that the angle clamp can be fixed to a work desk with two screws. The bottom-plate is equipped with a protruded ear at the vertex away from the side-plates. The ear is positioned to face the opposite vertex. A quick release mechanism with quick acting button and half-threaded nut is mounted in the notch of the ear so that it is free to rotate about its vertical axis. A threaded shaft is inserted through the half-

threaded nut in the direction of the diagonal of the bottom-plate. The threaded shaft can be swung horizontally with the half-threaded nut in various directions other than 45 degrees to the edges of the bottom-plate. Attached to the outside end of the threaded shaft is a handle for turning the threaded shaft inward or outward to clamp or release the workpieces. A right-angle head is mounted to the inside end of the threaded shaft through a pivoted block so that the right-angle head is free to swivel for an angle horizontally. Hence it is called the floating right-angle head. These features are designed to clamp workpieces of different sizes against the side-plates at a two dimensional 90-degree relationship (X and Y axes).

The floating right-angle head is equipped with two tooling holes, one on each clamping surface. Inserts like leveling pads can be inserted with adjustable protrusion so that the workpieces can be clamped with desirable working clearance from the floating right-angle head to make enough room for welding or other work process on the workpieces.

The outside walls of the two side-plates are machined flat and square so that the angle clamp can be laid sideway, or used in an upright position to hold a workpiece perpendicular to the surface of the work desk without the help of a fixture or mounting screws.

A Z-axis attachment can be mounted by screws to the two side-plates accurately and securely. This Z-axis attachment comprises two side-plate extensions joined at one side at 90-degree relationship, a swing away clamping arm with quick release mechanism at the free end, a threaded shaft fed through the quick release mechanism and a clamping head pivoted to the inner end of the threaded shaft. The threaded shaft is positioned along the same direction as the one mounted on the bottom-plate when the clamping arm is at its clamping position. By turning this threaded shaft inward, a third workpiece can be clamped against the corner of the two side-plate extensions of the Z-axis attachment at a position perpendicular to the bottom-plate. As a result, three workpieces can be clamped in three dimensional relationship along three mutually perpendicular directions (X, Y and Z axes) with the setup of one clamping device. In welding applications, the Z-axis attachment is also needed to hold the third welded part securely in place, and to counteract the contraction force induced by a cooling weld.

The assembled workpiece, which may be very bulky, can be removed easily with the clamping arm of the Z-axis attachment swung away to one side of the angle clamp.

The two quick release mechanisms, one mounted on the bottom-plate and the other mounted at the free end of the clamping arm of the Z-axis attachment, are provided for feeding the corresponding threaded shaft. Each quick release mechanism consists of a spring-loaded half-threaded nut connected to a quick acting button. When the quick acting button is pressed, the threaded surface of the half-threaded nut is pushed away from the surface of the threaded shaft. The threaded shaft, and hence the clamping head can be pushed in or pulled out rapidly through the nut with the desirable distance. The screwing action is resumed when the quick acting button is released.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the angle clamp without the Z-axis attachment.

FIG. 2 is a perspective exploded view of the quick release mechanism mounted on the bottom-plate.

FIG. 3 is a perspective view of the angle clamp with leveling pads attached to the floating right-angle head clamping workpieces along X and Y directions.

FIG. 4 is a perspective view of the angle clamp resting vertically on a work bench holding a cylindrical workpiece at the upright position.

FIG. 5 is a perspective view of the angle clamp with the Z-axis attachment's swing away clamping arm in the open position.

FIG. 6 is a perspective view of the angle clamp with the Z-axis attachment clamping workpieces along X, Y and Z directions.

DETAILED DESCRIPTION OF THE INVENTION

With the help of the drawings and the detail description below, the features of the present invention will be apparent and fully understandable.

Referring to FIG. 1, the angle clamp **1** comprises three mutually perpendicular base plates, a square shape bottom-plate **2**, two rectangular side-plates **3** and **4**, and a floating right-angle head **5** attached to a threaded shaft **6** with handle **7**. The two side-plates **3** and **4** are located at two adjacent edges of the square shape bottom-plate **2** so that both are perpendicular to the bottom-plate **2** and at right angle to each other. Two slotted holes **8** and **9** are provided along the other two adjacent edges of bottom-plate **2** for accepting screws to fix the angle clamp **1** to a work desk. At the vertex of these two adjacent edges, a vertical ear **10** is equipped at 135 degrees to these edges for feeding the threaded shaft **6**. Threaded shaft **6** is fed through a quick release mechanism **11** pivoted at the upper center of ear **10** in a normal direction at 45 degrees to the edges and pointing to the opposite vertex of the bottom-plate **2**. The threaded shaft **6** can be swung horizontally with the quick release mechanism **11** at a certain angle away from the normal 45-degree direction for better clamping of workpieces of different shape and sizes. Floating right-angle head **5** is pivoted to the inner end of the threaded shaft **6** and rests on the flat surface of the bottom-plate **2**. Floating right-angle head **5** is free to swivel horizontally and to slide on the flat surface of bottom-plate **2** for better clamping of workpieces. Two workpieces can be clamped at right-angle to each other between the right-angle head **5** and the inside surfaces of the two side-plates **3** and **4** along two mutually perpendicular axes, say X and Y axes. To the outside end of the threaded shaft **6**, a handle **7** is attached for turning the shaft **6** clockwise or counterclockwise.

Referring to FIG. 1 and FIG. 2, quick release mechanism **11** with quick acting button **12** is built into ear **10**. Instead of moving slowly pitch by pitch by turning the threaded shaft **6**, the right-angle head **5** can be moved forward or backward quickly with handle **7** by pressing the quick acting button **12** to release the engagement of the threaded shaft **6** with the half-threaded nut **13**. FIG. 2 shows the internal construction of the quick release mechanism **11** in

detail. It comprises the quick acting button **12** with half-threaded nut **13**, helical spring **14**, sleeve **15**, cover plate **16** and two screws **17**. Quick acting button **12** is actually part of the half-threaded nut **13** which is threaded on the lower surface of the hole for feeding the threaded shaft **6**. It is inserted into the center of the sleeve **15** with helical spring **14** in between. Two holes **19** just big enough to feed threaded shaft **6** freely are equipped on both sides of the sleeve **15**. Sleeve **15** is inserted onto a recess area at the bottom of ear **10** so that it is free to rotate about its vertical axis. Quick acting button **12**, half-threaded nut **13**, helical spring **14** and sleeve **15** are retained in position by cover plate **16** and two screws **17** which are screwed into holes **18** on the top surface of ear **10**. Threaded shaft **6** is fed through holes **19** and half-threaded nut **13**. In normal position, threaded shaft **6** is engaged with the thread inside the hole of half-threaded nut **13**. When the quick acting button **12** is pressed, the thread of half-threaded nut **13** is disengaged from threaded shaft **6** so that shaft **6** is free to slide inside nut **13**, hence the floating right-angle head **5** is free to slide over the surface of the bottom-plate **2** for quick and easy clamping and releasing of the workpieces.

FIG. 3 shows two workpieces **44** and **45** clamped in place along the X and Y axes. Two tooling holes **21** and **22** are equipped in the floating right-angle head **5**, one on each clamping surface. Leveling pads **23** and **24** are inserted to the tooling holes **21** and **22** respectively and locked in position by nuts. With the leveling pads **23** and **24** in place, clearance between the workpieces and the floating right-angle head **5** is provided for increased welding access. The screw and nut design of the leveling pads **23** and **24** enables the adjustment for the required clearance.

With reference to FIG. 3 and FIG. 4, the outside surfaces of side-plates **3** and **4** are machined flat and square. Hence the angle clamp can be laid vertically with either the outside surface of side-plates **3** or the outside surface of side-plate **4** rest on the work desk to clamp a workpiece perpendicular to the surface of a work desk without the aid of other fixture or device. FIG. 4 shows the angle clamp **1** resting vertically with the outside surface of side-plate **4** on a work desk. The floating right-angle head **5** is clamping a cylindrical

workpiece **43** to the inside surface of the side-plate **3** but vertically to the surface of the work desk.

Referring to FIG 5 and FIG. 6, the Z-axis attachment comprises a right-angle metal plate **30**, a clamping arm **31** with quick release mechanism **32**, a mounting block **33** and a threaded shaft **34** with clamping pad **35** and turning knob **36**. The right-angle metal plate **30** is mounted by screws to the two side-plates **3** and **4** and acts as an extension of the side-plates **3** and **4**. The inside surfaces of the metal plate **30** is machined square and flat and made to be align with the inside surfaces of side-plates **3** and **4** so that workpieces **40, 41** and **42** can be clamped at a three dimensional mutually perpendicular relationship (along X, Y and Z axes). Two holes are provided on one side of the metal plate **30** to attach the clamping arm **31** through mounting block **33** with two screws **37**. Clamping arm **31** is mounted to the mounting block **33** through a shaft inserted into mounting block **33** so that the clamping arm can be rotated about the axis of the shaft for an angle of approximately 135 degrees. This design enables the clamping arm **31** to be swung away from its clamping position to the open position for rapid and easy removal of the bulky finished workpiece. At the free end of the clamping arm **31**, a quick release mechanism **32** is built into the rectangular shape block. This quick release mechanism **32**, which is similar in design as the quick release mechanism **11** mounted in the ear **10** of the bottom-plate **2**, comprises a quick acting button with half-threaded nut and a helical spring. Threaded shaft **34** is screwed into the half-threaded nut of the quick release mechanism **32**. Clamping pad **35** is pivoted to the inside end of threaded shaft **34**, and to the outside end a turning knob **36** is attached. This threaded shaft **34** is used to clamp a workpiece against the inside surfaces of the right-angle metal plate **30** along the Z-axis direction. FIG. 6 shows an example of clamping three workpieces along X, Y and Z axes at mutually perpendicular relationship. When the quick acting button is pressed, the half-threaded nut is disengaged from the threaded shaft **34** and the threaded shaft **34** can be pushed in or pulled out rapidly to adjust for workpieces of different thicknesses when clamping, or to remove the finished workpiece when releasing.